8-1-2006

Patient Controlled Epidural Analgesia in the Obstetric Patient

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PATIENT CONTROLLED EPIDURAL ANALGESIA IN THE OBSTETRIC PATIENT

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Bachelor of Science in Nursing, Minot State University, 2000

Independent Study

Submitted to the Graduate Faculty

Of the

University of North Dakota

For the degree of

Master of Science

Grand Forks, North Dakota

August

2006

TABLE OF CONTENTS

ABSTRACT

Patient controlled epidural analgesia (PCEA) allows patients to self-administer precise doses of opioid/ local anesthetic directly into the epidural space on an as needed basis. The majority of PCEA is used with maternal patients in the pre-partal period and Certified Registered Nurse Anesthetists (CRNA) are the primary individuals who assess and prescribe these medications. This independent project explored the current research published on PCEA. Topics covered included: risks and benefits of the prescribed medications, dosaging, options for basal (background) rate and/or patient controlled analgesia (PCA) patient satisfaction, benefits to fetus, procedures where PCA may be indicated, and contraindications of PCEA. A physiologic pain theory framework guided the paper. Questions addressed included: 1) What is the current state of pain controlled epidural analgesia research and recommendations for practice? 2) What medication combinations are being used to obtain optimal pain control? 3) Is there a need for background infusion rates? 4) Are there identified complications of PCA epidurals? 5) What are the benefits of having patient controlled epidural analgesia? 6) Is patient satisfaction increased with the addition of the PCA component? The independent study concludes with an analysis of best practices and present guidelines for CRNA's to use when prescribing

epidural analgesia. Finally recommendations for nursing practice, education, research and policy are presented.

Introduction

Patient controlled epidural analgesia is used for patients in labor, intraoperatively, postoperatively, cancer pain treatment, and chronic pain treatment. Most hospitals have been doing patient controlled intravenous medications, but a patient controlled epidural (PCE) is something relatively new. With PCE, patients self-administer medication directly into the epidural space via a catheter. With an epidural, the quality of pain relief has more to do with the volume of medication given rather that the concentration of medications given.

Contraindications to epidural anesthesia, whether patient controlled or not, include patient refusal, coagulopathy, platelet abnormalities, and presence of infection or tumor at the site of puncture. A relative contraindication is the presence of a systemic infection unless bacteremia is documented.

There are multiple benefits to the patient when using epidural anesthesia. Patients who receive narcotics via the epidural space require less pain meds than when administered intravenously. Patients are ready for discharge from the post-anesthesia care units earlier. Bowel motility returns quicker. Patients encounter less nausea and vomiting. Patients also report better pain control with patient controlled epidural anesthesia (PCEA) than with patient controlled intravenous (PCA) pain

medications. Reports of drowsiness are less. Overall increased patient satisfaction is seen with the patient controlled component of epidural anesthesia.

There are side effects with the epidural that need to be discussed. The one most commonly found is pruritis. It is reported more frequently with epidural anesthesia than with intravenous anesthesia. Narcan or benadryl are helpful in treating these. Bradycardia and hypotension are commonly found as well, but respond quickly to fluid boluses. If not, vasopressors (phenylephrine or ephedrine) may be used.

Epidural analgesia has benefits to the fetus as well. Neonatal exposure to opioids and sedatives can be minimized or totally avoided with epidural analgesia. While limiting the fetal exposure to the harmful effects of depressant drugs, epidural anesthesia and/or analgesia improves placental perfusion and oxygenation of the fetus, which is beneficial, especially in conditions such as pregnancy induced hypertension.

Clinical problem

Patients continue to rate pain control as a top priority in their surgical experience. We need to provide them with effective means of achieving that pain relief. Is PCEA (Patient Controlled Epidural Anesthesia) a viable option for the obstetric patient to control their pain?

Purpose Statement

The purpose of this project was to research and explore the current literature regarding patient controlled epidural anesthesia and produce a scholarly paper with the findings. The paper presents guidelines for CRNA's to use when prescribing epidural anesthesia.

Research Questions

The following research questions were addressed:

1) What is the current state of pain controlled epidural analgesia research and recommendations for practice?
2) What medication combinations are being used to obtain optimal pain control?
3) Is there a need for background infusion rates?
4) Are there any identified complications of PCA epidurals?
5) What are the benefits of having patient controlled epidural anesthesia?
6) Is patient satisfaction increased with the addition of the PCA component?

Physiological Framework

Labor is described as the process of expulsion of the fetus and the placenta from the uterus. There are three stages of labor. Pain during

the first stage of labor results from uterine contractions and cervical dilation. Pain during this stage of labor is mediated from the afferent nerve supply of the uterus via the sympathetic nerve which, ultimately reaches T10 – L1 segments of the spinal cord. Pain is usually carried by T11 – T12 dermatomes during the latent phase but eventually involves the T10-L1 dermatomes as the labor enters the active phase.

The first stage of labor pain has been described as referred pain. Pain during the first stage of labor results from uterine contractions and cervical dilation. This can be explained by the common neuronal pool supplying both the uterus and the anterior abdominal wall. Second stage labor pain is carried by the S2, S3, and S4 spinal segments. Also known as pudendal nerve. This nerve originates from the sacral plexus and accompanies the pudendal vessels across the ischial spine where the nerve can be blocked (Morgan, Mikhail, & Murray, 2002).

The nerves from the uterus together with other autonomic nerve fibers from the cervix form the interior hypogastric plexus. Fibers from the plexus traverse along the iliac vessels as the right and left hypogastric nerves. These nerves ultimately communicate with the superior hypogastric nerve and reach the sympathetic chain either directly or via the aortic plexus. These finally reach the spinal cord via the posterior nerve root aments, and fallopian tubes travel via ovarian nerves and ultimately reach the spinal cord via the aortic plexus and sympathetic chain. The nerves in the spinal cord relay to neurons of the

posterior horn cells and ultimately reach the central nervous system via the lateral spinothalamic tract (Datta, 2000).

Definitions

The following definitions were used in the paper:

1) Patient controlled epidural anesthesia (PCEA) allows the patient to self-administer precise doses of medications directly into the epidural space via a catheter.

2) Patient controlled analgesia – intravenously (PCA-IV) allows the patient to self-administer precise doses of medications directly into the intravenous circulation.

3) Labor is the process of expulsion of the fetus and the placenta from the uterus.

4) Fetus is the product of conception from the end of the eighth week to the moment of birth.

5) Multipara is a woman who has given birth at least two times to an infant, liveborn or not, weighing 500g or more having an estimated length of gestation of at least 20 weeks.

6) Para is a woman who has given birth to one or more infants.

7) First stage of labor starts from the latent phase of labor (progressive cervical dilation associated with regular uterine contraction) and terminates at the time of full dilation of the cervix.

8) Second stage of labor starts from full dilation of the cervix and terminates at the time of the delivery of the fetus.

9) Third stage of labor starts from delivery of the infant and terminates at the time of expulsion of the placenta.

10) Labor pain is described as the rhythmic uterine contractions that under normal conditions increase in intensity, frequency, and duration, culminating in vaginal delivery of an infant.

Assumptions/ Limitations

Assumptions are that the literature reviewed is correct, that it is not biased, and that the results are documented accurately. Limitations are that only data that has been published is available for review and that limited multi-study papers have been produced for review.

Literature Review

Complications

Sympathetic blockade happens more gradually than with the epidural block. There is usually enough time to treat this hypotension with fluids rather than with vasopressors. If the fluids are not enough, Ephedrine is the drug of choice as with spinals. Severe hypotension may be found with dehydration and/or hemorrhage, which would be relative contraindications to the epidural (Mulroy, 2002).

Intravenous injection is the most serious complication with the epidural. The veins usually collapse when aspirating making diagnosis difficult. The injection of local anesthetic solution before insertion of the catheter has shown to decrease the risk of threading the catheter into a vein. This happens in about 1 – 8% of epidurals. A careful test dose of lidocaine with epinephrine (3 ml's) should be given. The patient's heart rate will increase or there will be a metal taste in his/her mouth, ringing in the ears, or tingling in the fingers if there is intravenous injection. Total spinal anesthesia may also occur if the catheter has been inserted in the CSF instead of the epidural space. The treatment is converting to general anesthesia quickly. Having resuscitation equipment ready is essential (Mulroy, 2002).

Unilateral or patchy block may occur if the catheter has been advanced more than 5 cm into the epidural space. Some reports of air bubbles in the epidural space have been the cause of patchy anesthesia. Neuropathy or cord damage are also complications but happen rarely. They occur when the epidural is performed above the T2 level. Headache happens when the dura is punctured while attempting the epidural. A blood patch is used to treat this as well (Mulroy, 2002).

Retained catheter can happen if the catheter is attempted to be removed and the catheter is frayed off into the epidural space. This does not usually require removal but the patient needs to be aware of the foreign body. It is opaque and will show up on x-rays. Occasionally it

may be removed if it breaks the skin or creates a path for infection to the epidural space (Mulroy, 2002).

Epidural hematoma is rare. The patient usually has some preexisting coagulopathy, whether diagnosed or undiagnosed. An MRI is used to detect this and a decompressive laminectomy needs to be performed early to regain any deficits encountered (Mulroy, 2002).

Epidural abscess may occur as well. This needs to be done as a sterile procedure. The immunocompromised patient is at an increased risk. Also, the wrong solutions have been administered through an epidural catheter. The catheter needs to be clearly marked to detour any confusion (Morgan, Mikhaill, and Murray, 2002).

Medications/Dosage

Multiple local anesthetics have been used for epidural analgesia. Some examples are 2-cloroprocaine in both a 2% and 3% solution (provides 45–60 min of anesthesia), Lidocaine 1.5% or 2% (provides 60-90min of anesthesia), Bupivacaine 0.5% and 0.75% (provides the longest block), Ropivacaine 0.2%, 1% and 0.75% (the higher doses are needed for longer blocks). With epidurals, the dosage depends on many factors. The major factors are the patient's age and site of injection, but patients weight, height, position and pregnancy also have a minimal effect. Decreased anesthesia is required with age and weight. For lumbar injection the standard dose is 10-15 ml before starting the continuous drip.

Medications administered through the epidural space include local anesthetics, opioids, and steroids. The following is a list of medications found in the literature that are being used for patient controlled epidural anesthesia.

- Ropivacaine 0.125%
- Morphine
- Fentanyl
- Bupivacaine 0.125%
- Hydromorphone
- Sufentanil
- Buprenorphine 20mcg/ Droperidol 0.1mg (Avoid in pregnancy)
- Bupivacaine 0.125%/ Sufentanil 0.75 mcg @3 ml/hr
- Bupivacaine 0.1%/ Fentanyl 3 mcg/ml @ 5 ml/hr
- Meperidine 5 mg/ml @ 10 mg/hr
- Bupivacaine 0.015%/ Buprenorphine 3 mcg/ml/ epinephrine 1 mcg/ml
- Bupivacaine 0.015% Fentanyl 3 mcg/ml with/without epinephrine
- Methadone 0.75-1.5 mg (0.1-0.2 mg/hr)
- Clonidine (48-800 mcg/day) – higher doses more likely to cause hypotension and bradycardia - neuropathic pain
- Baclofen – neuropathic pain
- Butorphanol

In an article from Broder, Mertes, Van Aken, Mollhoff, Zahl, Wirtz, Marcus and Buerkle (2000), the concentration of sufentanil with ropivacaine 0.2% was researched. Four groups of patients were observed. One group received just ropivacaine, one group received ropivacaine +sufentanil 0.5 mcg/ml, and one group with ropivacaine + sufentanil 0.75 mcg/ml, and ropivacaine + sufentanil 1.0 mcg/ml. Analgesia was best in patients with 0.75 mcg/ml of sufentanil. No further improvement was noted with 1.0 mcg/ml of sufentanil. Sufentanil 0.75 mcg/ml was shown to have the most effectiveness. No benefit was noted with increased doses.

In an article by Yu and Gambling (1993), PCE fentanyl was compared to a single dose epidural morphine. One group of patients was given 100 mcg of fentanyl intraoperatively and fentanyl (50 mcg X 2) per hour via PCEA. The other group was given a single dose of 0.3 mg morphine intraoperatively, then a PCA-IV with 0.9% NS. They were assessed over a 24 hour period, finding that pain relief, satisfaction with pain relief, and the use of supplemental analgesics were similar in both groups. They found that PCEA fentanyl provides equal anesthesia to the single dose of epidural morphine with the benefit of decreased pruritis.

Owen, D'Angelo, Gerancher, Thompson, Foss, Babb, and Eisenach (1998) did a study that compared 0.125% ropivacaine to 0.125% bupivacaine for labor analgesia using patient-controlled epidural infusion. The study had fifty-one patients with an ASA class of I or II.

This was a randomized double-blinded study. Patients were given a basal rate of 6ml/hr with patient controlled boluses of 5ml every 10 min as needed. If the analgesia was still inadequate, 10 ml bolus of the same solution was given. There were no differences in verbal pain scores, amounts of local anesthetics used, sensory levels, motor blockade, labor duration, mode of delivery, side effects, or patient satisfaction between the two local anesthetics. They concluded that 0.125% ropivacaine and bupivacaine are clinically indistinguishable and are both highly effective for labor analgesia.

The concentration of ropivacaine and fentanyl in PCEA during labor was studied by Bernard, Le Roux, and Frouin (2003). Two groups of patients were established. One group with 0.1% ropivacaine/ 0.5mcg/ml fentanyl and the other with 0.2% ropivacaine/ 1 mcg/ml fentanyl. They concluded that there is no clinical reason for increasing the concentration of PCEA solution when labor becomes active if an affective dose is already being administered with each demand. The patient satisfaction was unchanged.

The effects of obstetric analgesics and anesthetics on the neonate were studied by Mattingly, D'Alessio, and Ramanathan (2003). They found that regional analgesia can minimize or totally avoid exposure to the neonate. Repeated maternal administration of opioids such as meperidine results in significant fetal exposure and neonatal respiratory depression.

Background Infusion Rates

There are mixed reviews whether there is benefit to adding a background infusion with the patient controlled epidural dose. In an article by Wong, Chong, Lo, and Sia, the addition of a background infusion rate increased the rate of side effects and total drug consumption, but the pain scores and patient satisfaction were unchanged. Two groups of patients were evaluated using a mixture of 0.2% ropivacaine with 2 mcg/ml fentanyl. One group with PCEA only and one group with PCEA plus background infusion rate.

Patients that benefit from a background infusion are those requiring large amounts of opioids (example: cancer/ chronic pain) and those that experience breakthrough pain. This allows the patient to have a more constant level of control while offering additional bolus as needed. This may also allow the basal rate of opioid to decrease.

In a study by Lim, Sia, and Ocampo, computer integrated patient controlled epidural analgesia was compared to conventional patient controlled epidural analgesia (demand only) for pain relief in labor. They wanted to demonstrate equivalence in the hourly consumption of local anesthetic solution in both groups. 40 parturients were recruited and approved by the ethics committee with informed written consent. This was a randomized, double blinded, controlled trial. Each patient was at 5 cm dilation with baseline pain scores of > or = to 5. Patients excluded in the study included any patient who received parenteral opioids < 2hr

earlier or had baseline pain scores <5 before CSE (combined spinal epidural), pre-eclampsia, multiple gestation, macrosomia, diabetes, and malpresentations. All patients received a CSE in the left lateral decubitus position. Ropivacaine 2mg with 15 mcg fentanyl diluted with normal saline to a total of 2ml injected intrathecally. Epidural catheter was then placed and tested in the usual manner. Two groups of patients were established. First group received PCEA with no background infusion, and epidural bolus of 5ml ropivacaine 0.1% with fentanyl 2mcg/ml on demand, lock out period of 15 min with a maximum dose of 20ml/hr. Group two received a computer integrated PCEA using the same anesthetic and opioid solution. The starting background infusion was zero, but if the patient required one demand bolus in the previous hour, the background infusion would increase by 5ml/hr. If the patient required two demand doses the background infusion would go up to10ml/hr. The maximum background infusion rate was 15ml/hr. Also if the patient did not require a demand bolus in the previous hour, the background infusion rate would decrease by 5ml/hr. This study found that computer integrated PCEA does not increase the use of local anesthetic when compared with demand only PCEA but does increase patient satisfaction (93% vs. 86% with demand only PCEA). The increased patient satisfaction may be linked to less breakthrough pain than with demand only PCEA. The computer integrated PCEA may reduce the amount of local anesthetic used in the earlier stages of labor.

In an article by Gambling, Yu, Cole, McMorland, and Palmer, they discussed a comparative study of patient controlled epidural analgesia (PCEA) and continuous infusion epidural analgesia (CIEA) during labor. This was a single-blinded placebo controlled study with 27 patients in labor receiving 0.125% bupivacaine. Group A received a background infusion of 4 ml/hr with 4 ml boluses when the patient demanded with a 16 ml/hr maximum. Group B received a continuous infusion of 12 ml/hr but the demand button was disabled. They concluded that PCEA is safe, effective means of analgesia during labor, with increased patient satisfaction.

Patient controlled epidural analgesia after caesarean section using meperidine was studied by Ngan Kee, Khaw, and Ma (1997). This was a randomized double-blinded study with 40 patients. One group of patients was given a background infusion while the other group was not. They found that the addition of a background infusion to PCEA using meperidine after caesarean section had no clinical benefit.

Patient controlled epidural analgesia

In an article by Parker and White (1992), PCEA was studied as alternative to intravenous PCA (IV-PCA) for pain relief after cesarean delivery. There were 117 patients in this study. They were randomly given hydromorphone either IV-PCA or PCEA. The PCEA group utilized significantly less opioid medication, but pain and sedation scores were similar. The IV-PCA group reported more drowsiness on the first

postoperative day. Pruritis was higher in the PCEA group, but nausea was higher in the IV-PCA group.

PCEA was compared to conventional intermittent "top-off" injections during labor in a study by Gambling, McMorland, Yu, and Laszlo (1990). This was a randomized, prospective study. PCEA group received 4ml increments of 0.125% bupivacaine with 1:400,000 epinephrine to a maximum of 12ml/hr. The conventional top off patients received 12ml of the same solution on request from the anesthesiologist. Pain control was similar in both groups, but the patient satisfaction was increased in the PCEA group.

In an article by Gordon, Gaines, and Hauber (1994), self-administered epidural analgesia versus nurse-administered analgesia after cesarean section was studied. They conducted a quasi-experimental study with 51 women. The self-administered analgesia group used significantly less medication with fewer supplemental IV pain medications than the nurse-administered analgesia group.

Halpern (2005) reviewed the recent advances in patient controlled epidural analgesia. The purpose was to show that there were benefits of using patient controlled versus continuous infusion analgesia. He found that bupivacaine and ropivacaine were the most used medications, with ropivacaine showing the least amount of motor blockade. The results of this article were that PCEA has been proven to be a safe and effective method of pain control and increasing patient satisfaction.

In an article by Nikkola, Laara, Hinkka, Ekblad, Kero and Salonen (2006), they found that PCEA does not improve maternal satisfaction. They followed ninety mothers with term, uncomplicated pregnancies. They were divided into three randomized groups. The first group was given intermittent boluses of bupivacaine with fentanyl, the second group was given PCEA with bupivacaine and fentanyl, and the third group was given PCEA with just bupivacaine. They found that maternal satisfaction was not improved with PCEA over intermittent boluses.

Implications for Nursing

Practice

Pain control in the obstetric patient is an essential component of the labor process. It is imperative that Certified Nurse Anesthetists be aware of the modalities available to them to provide the best care possible to their patients. They need to keep up with the new medications being used today and their complications. The need to understand how to treat the complications is they arise. All these aspects will allow them to make the most appropriate choices for their patients.

Research

With the obstetrical population having increased options for pain control, research is more important than ever. It allows nurse anesthetists to get information on various ways of practice, complications, medications, as well as new information in a concise form

with statistics to back up the findings. This will guide the practice of nurse anesthetists.

After collecting all the articles for this independent project, I found that the information gained lead to the conclusion that patient controlled epidural analgesia was a good alternative for pain control. Further recommendations of study would be to conduct studies with vast numbers of participants (ex. 500 patients). Most of the studies were with limited number of participants. I also think that multiple studies with the same combination of medications would also be helpful. There is a variety of combinations being used with no specific recommended dosages.

Education

In order for analgesia to be provided safely by nurse anesthetists, there must be ongoing education. Medications, dosages, and combinations are changing all the time. Nurse anesthetists should continually be reading journals, attending anesthesia conferences, participating in organizations that relay information on important topics such as this. Education ensures that the current information reaches the practicing nurse anesthetists to help guide their practices.

As the public becomes more aware of their options for pain control, it is important for the nurse anesthetist to educate patients with the current information available.

Policy

There are many ways of providing an anesthetic plan. It needs to be individualized to each patient's specific needs. Pathways are a tool the hospitals use to assess the patients progression toward wellness. These pathways are developed with the latest in anesthesia research and education. They are there to improve patients care and satisfaction.

Conclusion

The obstetric patient has a very unique set of risks involved with providing anesthesia to them; you not only have one patient to consider but two patients to consider when choosing the appropriate anesthesia plan. That fact needs to always be thought of. PCEA provides benefits to both the mother and the fetus. This is very beneficial and needs to be utilized for its benefits. PCEA comes with a wide variety of options so it can be fine tuned to each specific patient and their needs, while minimizing the risks to the fetus. The current research shows PCEA to be a viable and effective method of pain relief for the laboring patient. Appendix A lists some valuable information for the nurse anesthetist in providing PCEA to their patients. It will allow nurse anesthetists to quickly familiarize themselves with the basics in PCEA and to help guide in the appropriate plan for their patients.

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Appendix A

Guidelines for Epidural Analgesia

- Most common meds used: lidocaine 1%, chloroprocaine 2%, bupivacaine 0.25%, ropivacaine 0.2%
    - local anesthetics with opioid combinations use most commonly:
        - 0.1-0.2% ropivacaine or 0.0625-0.125% bupivacaine with either 50-100 mcg of fentanyl or 10-20 mcg of sufentanil
- Positioning: sitting or side lying, sitting is easier with obese patients to identify the midline
- Incidence of wet taps is OB: 1-4%
- If using air for loss of resistance, try to limit air as much as possible due to patchy or unilateral blocks.
- Average depth of epidural space in OC patients is 5cm from skin.
- Placement of catheter @ L3-4 or L4-5 to achieve T10 – S5 neural blockade.
- If wet tap occurs there are two choices:
    - place the epidural catheter in the subarachnoid space for continuous spinal analgesia
    - remove needle and attempt placement at a higher spinal level.
- Always give a test dose of 3-4 ml of local anesthetic with1:200,000 epinephrine
    - wait at least 5 min (increase HR by 20-30 beats/min with in 30-60 seconds, tinnitus, perioral numbness)
- Start gtt at 10-15 ml/hr, increase by 4ml every 15 min until comfortable, maximum hourly dose of 26 – 31 ml/hr

- Management of complications:

1) Hypotension (most common side effect of regional anesthesia)– 20-30 % decrease in BP or a systolic pressure less than 100 mmHg
    - Give IV fluid bolus, 5-15 mg boluses of ephedrine, 25- 50 mcg boluses of phenylephrine

2) Unintentional intrathecal injection
    - may attempt to aspirate if recognized immediately
        - usually unsuccessful
    - place supine, left uterine displacement (LUD)
    - NO head elevation – accentuates hypotension
    - treat hypotension with ephedrine and fluid boluses
    - if high spinal results, intubate and ventilate with 100% ventilation

3) Unintentional intravascular injections
    - may present with seizures
        - thiopental 50-100 mg
        - small doses of propofol may also be helpful but
            - experience is limited
    - maintain patent airway and adequate oxygenation
    - intubation with succinycholine and cricoid pressure may be necessary
    - If bupivacaine was used, rapid and profound cardiovascular collapse as well as seizures
        - resuscitations is exceedingly difficult
        - aggravated by acidosis and hypoxemia
        - Bretylium and possibly amiodarone may be useful in reversing bupivacaine-induced
        - decreases the threshold for ventricular tachycardia

4) Post-dural Puncture Headache (PDPH)
    - due to decreased intracranial pressure with compensatory cerebral vasodilation

    Mild Headaches

    -bedrest, hydration, oral analgesics, epidural saline injection (50-100ml), caffeine sodium benzoate (500mg IV) may be effective

    Moderate to Severe Headaches

    -epidural blood patch (10-20 ml of patients own blood)
    -prophylactic epidural blood patch is generally not recommended.
    -delaying a blood patch for 48 hrs may increase is efficacy